REPORT FROM THE ITU-R WORKING PARTY 7A ON TIME SIGNALS AND FREQUENCY STANDARD EMISSIONS

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Abstract

The Working Party 7A (WP-7A) on"Time Signals and Frequency Standard Missions" is one of the four Working Parties of Study Group 7 "Science Servives" (SG 7) of the Radiocommunication Sector of the International Telecommunication Union (ITU-R). The subjects which are addressed in the WP-7A meetings on the basis of input documents as answers to Questions are: (worldwide) Standard frequency and time (T&F) dissemination from terrestrial transmitters and from satellites, including GPS, GLONASS, and Two-Way Satellite T&F transfer, time codes, requirements for high precision time, performance of T&F standards, time scale stability characterization, signal delays in antennas and other circuits, time delay measurements, compensation methods in SDH/SONET systems, etc. The results of the discussions during the meetings are presented, preferably in the form of ITU-R Recommendations to the ITU member states.

Also, for the purpose of communication of the best use and selection of T&F systems to a wide group of users, the writing of handbooks in WP-7A has been started with contributions from internationally recognized specialists. The manuscript of the first handbook has been finished under Dr. R. Sydnor as main editor and D.W. Allan as co-editor. The English version has been prepared for press and is also being translated into French and Spanish.

Several ITU-R Study Group and Working Party meetings were held in Geneva in October 1996. The results of the last WP-7A meeting, held 8 to 16 October 1996, are presented.

ITU-R Working Party 7A Schedule

1996	
	Publication of accepted Recommendations: 1995 TF Series Fascicle
Oct 8-16	**Meeting WP 7A in Geneva**
Oct 17-18	**Meeting of Study Group 7 in Geneva**
	Publication TF Handbook Selection & Use Precise T/F Systems

Report Documentation Page

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1997	
June 2-6	Meeting WP 7A
June	Meeting SG 7
Oct	Meeting Radiocommunication Assembly
1998	Publication accepted Recommendations: 1997 TF Series Volume

Draft revision of Question ITU-R 111/7

Signal Delays in Antennas and other Circuits and their Calibration for High-Accuracy Time Transfer

* What methods can be recommended and standardized to calibrate delay introduced by antennas and associated circuits for accurate time transfer (down to below one nanosecond)

* What parameters influence the delay

• What environmental effects affect delay

* What level of agreement exists between calibrated Two-Way and GPS/GLONASS Time Transfers

* what standard reference systems would be useful for calibration purposes

Draft revision to Question ITU-R 206/7

Frequency Comparisons of Remotely Located Standards at the 10^{-15} Level of Uncertainty

The ITU Radiocommunication Assembly,

Considering

- that the stability of primairy and some commercial frequency standards at the 10^{-14} level at one day and expected to improve to the 10^{-16} level;

- that present time transfer are at best stable to about one nano second and need an integration time of many days to reach a frequency transfer at 10^{-15} level;

- that ....;

***decides* that the following Questions should be studied**

***How can frequency be transferred at the 10^{-15} level within a day?**

***What means of self calibration and self monitoring are needed for these highly reproducible and accurate transfers?**

Draft revision of Recommendation ITU-R TF.768-2

Standard Frequencies and Time Signals

(Question ITU-R 106/7)

Additions and revisions to the Annex, tables 1 and 2

DCF 77, WWVB, Loran-C, etc.

Draft revision of Recommendation ITU-R TF.583-3

Time Codes

(Question ITU-R 110/7)

Additions and revisions to the Annex1, figures and tables

DCF 77, WWVB, IEN/RAI, etc.

Draft revision of Recommendation ITU-R TF.1153

The Operational Use of Two-Way Satellite Time and Frequency Transfer emplying PN codes.

(Question ITU-R 201/7)

Addition: File Format for reporting results of a quadratic fit and other parameters.

ANNEX 2.A

DATA LINE:

```
         0         0         0         0         0         0         0         0         0         1         1         1         1
         1         2         3         4         5         6         7         8         9         0         1         2         3
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890

* EARTH-STAT  LI  MJD  STTIME NTL        TW        DRMS SMP ATL     REFDELAY      RSIG  CI S    CALR      ESDVAR    ESIG TMP HUM PRES
* LOC     REM           hhmmss  s         s          ns       s         s           ns              ns         ns       ns degC  %  mbar
LLLLnn LLLLnn LL MMMMM hhmmss nnn +0.nnnnnnnnnnnnn n.nnn nnn nnn +0.nnnnnnnnnnnnn n.nnn CCC i +nnnnn.nnn +nnnnn.nnn n.nnn +nn nnn nnnn
```

EXAMPLES

The examples contain actual and fictious data (especially for calibration).

```
* TWUSNO49.933
* FORMAT     01
* LAB        USNO
* REV DATE   1995-07-10
* ES USNO01 LA: N  38 55 00.000      LO: W  77 04 00.000   HT:    51.30 m
* REF-FRAME WGS84
* LINK   04 SAT: IS706               NLO: W  53 00 00.000  XPNDR: 99999.999 ns
*           SAT-NTX: 11922.3750 MHz  SAT-NRX: 14221.6275 MHz
* CAL    002 TYPE: GPS               MJD: 49639  EST. UNCERT.:    5.000 ns
* CAL    003 TYPE: GPS               MJD: 49649  EST. UNCERT.:    5.000 ns
* LOC-MON    NO
* MODEM      MITREX 2500A
*
* EARTH-STAT  LI  MJD  STTIME NTL        TW        DRMS SMP ATL     REFDELAY      RSIG  CI S    CALR      ESDVAR    ESIG TMP HUM PRES
* LOC     REM           hhmmss  s         s          ns       s         s           ns              ns         ns       ns degC  %  mbar
USNO01  TUG01 04 49933 140200 299  0.263265762933 1.529 300 299  0.000001334100 9.999 002 1   296.350 99999.999 9.999  32  63  994
USNO01  NPL01 04 49933 141000 299  0.260419315503 0.613 300 299  0.000001334200 9.999 999 0 99999.999 99999.999 9.999  32  63  994
USNO01  VSL01 04 49933 141800 299  0.261451406897 0.387 300 299  0.000001334200 9.999 999 0 99999.999 99999.999 9.999  32  63  994
USNO01  PTB01 04 49933 143400 299  0.262748501558 1.822 233 232  0.000001334240 9.999 003 1   449.500 99999.999 9.999  32  63  994

* TWTUG49.933
```

N:\BRSGA\TEXT96\SG7\7\000\019E.DOC

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```
* TWUSNO49.933
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* CAL    002 TYPE: GPS               MJD: 49639  EST. UNCERT.:    5.000 ns
* CAL    003 TYPE: GPS               MJD: 49649  EST. UNCERT.:    5.000 ns
* LOC-MON    NO
* MODEM      MITREX 2500A
*
* EARTH-STAT  LI  MJD  STTIME NTL       TW        DRMS SMP ATL     REFDELAY     RSIG  CI S    CALR     ESDV
* LOC    REM          hhmmss  s         s          ns       s         s           ns             ns       ns
USNO01  TUG01 04 49933 140200 299  0.263265762933 1.529 300 299  0.000001334100 9.999 002 1   296.350 99999.
USNO01  NPL01 04 49933 141000 299  0.260419315503 0.613 300 299  0.000001334200 9.999 999 0 99999.999 99999.
USNO01  VSL01 04 49933 141800 299  0.261451406897 0.387 300 299  0.000001334200 9.999 999 0 99999.999 99999.
USNO01  PTB01 04 49933 143400 299  0.262748501558 1.822 233 232  0.000001334240 9.999 003 1   449.500 99999.
```

Draft New Opinion

Operational Use of Geostationary Direct TV Satellites for Time transfer

(Question ITU-R 103-1/7)

Considerings:

- availability of direct TV satellites

- positioning tolerance +/- 0.1 degree

- common view accuracy 10 ns when satellite position is known good enough

Opinion:

*** TV satellite operators should make available the satellite coordinates with a resolution for example up to 100 m each 60 minutes. This could be done on an Internet site or incorporated in the TV signal**

Draft New Opinion

Future Use of the Global Navigation Satellite System (GNSS) for High-Precision Time Transfer

(Questions ITU-R 103-1/7 and 152-1/7)

Considerings:

- satellite navigation signals have been simulaneously used for distribution of time and frequency

- a new enhanced system (GNSS) will be intoduced in 1998 to 1999

- time oriented navigation receivers showed uncertainties below 10 ns

Opinion:

*** new time-oriented receivers should be studied and developed**

*** suitable delay calibration methods should be developed to enable uncertainties less than 1 ns**

Liaison Statement to ITU-T Study Group 13, Working Party

Cooperation in the study and developement of Time Transfer and/or Distribution using overhead capacity in SONET/SDH Networks

Contact Points for WP 7A:

*** D.W. Hanson, NIST, Boulder, CO., USA**

and:

*** T.R. Bartholomew, TASC, Anapolis Junction, MD., USA.**

Handbook on the Use of Satellite Time and Frequency Dissemination

editor: J.McA. Steele (UK)

*** manuscript planned to circulate December 1996.**

Handbook on the Selection and Use of Precise Frequency and Time Systems

main editor: R. Sydnor (USA)

*** accepted and in press at the ITU, Geneva.**